What Is Claimed Is:

1. An optical data signal transmitter comprising:

at least one optical carrier generator, each generating an optical carrier signal having two side frequencies derived from a source frequency;

at least one data modulator for modulating data onto the at least one optical carrier signal, creating at least one optical data signal including modulated data and having a first polarization state; and

at least one polarization transformer for encoding a portion of the modulated data and a first of the two side frequencies of the at least one optical data signal with a second polarization state, the second polarization state being orthogonal to the first polarization state.

2. The optical data signal transmitter of claim 1, wherein the at least one data modulator modulates data onto information bands, each information band centered at one of the two side frequencies of the at least one optical carrier signal respectively.

3. The optical data signal transmitter of claim 2, further comprising:

at least two optical source signal generators, a first source signal generator producing a first source frequency, a second source signal generator producing a second source frequency, each source frequency being transmitted to one of the at least one optical carrier generators, resulting in first and second optical carrier signals;

a plurality of data signal generators, the signals generators each transmitting a data signal at a data rate to a data modulator, each modulator modulating a pair of data signals in quadrature onto the first optical carrier signal, resulting in a first optical data signal and modulating a different pair of data signals in quadrature onto the second optical carrier signal, resulting in a second optical data signal; and

at least one phase shifter coupled to a data modulator, the at least one phase shifter modifying a phase of one of the pair of data signals modulating the first optical carrier signal, and one of the pair of data signals modulating the second optical carrier signal.

4. The optical data signal transmitter of claim 3, wherein the first and second source frequencies are separated by at least 50 GHz.

5. The optical data signal transmitter of claim 4, wherein the at least one polarization transformer changes one of the first and second data optical data signals from a first polarization state to a second polarization state.

6. The optical data signal transmitter of claim 5, wherein the two side frequencies of the optical carrier signal are located at least three times the data rate in GHz above and below the source frequency.

7. The optical data signal transmitter of claim 6, wherein the at least one optical carrier generator includes a Mach-Zehnder interferometer.

8. The optical data signal transmitter of claim 5, further comprising:

at least one optical combiner coupled to a source signal generator and at least one data modulator, the at least one optical combiner combining an optical data signal with a source frequency, the optical combiner outputting a combined signal, the combined signal including two information bands at side frequencies and the source frequency, the source frequency occupying a central frequency between the two information bands.

9. The optical data signal transmitter of claim 8, further comprising:

an optical multiplexer coupled to at least one optical combiner, the optical multiplexer multiplexing a first combined signal having a first polarization state and a first source frequency with a second combined signal having a second polarization state and a second source frequencies;

wherein the optical multiplexer filters out information bands, and passes only an information band occupying a frequency range in between the first and second original source frequencies, the information band after multiplexing including data from both the first and second combined signals.

10. The optical data signal transmitter of claim 1, wherein the at least one optical carrier generator produces an optical carrier signal that includes the source frequency and the at least one data modulator imprints data onto an information band centered at the source frequency.

11. The optical data signal transmitter of claim 10, further comprising:

a plurality of optical filters coupled to an optical carrier signal generator;

wherein an optical carrier signal is passed to the plurality of filters, the filters separating component frequencies of the carrier signal and outputting three carrier sub-signals, a first sub-signal including one side frequency, a second sub-signal including the source frequency and a third sub-signal including another side frequency, each sub-signal being transmitted to a different one of the at least one polarization transformers, the first sub-signal being transformed to a first polarization state, the second sub-signal being transformed to a first and a second polarization state, and the third sub-signal being transformed to a second polarization state, the first, second and third sub-signals being combined into a modified optical carrier signal.

12. The optical data signal transmitter of claim 11, further comprising:

a source signal generator, the source signal generator producing a source signal having the source frequency; and

a plurality of data signal generators;

wherein the plurality of data signal generators each transmit a data signal to at least one data modulator, the at least one data modulator modulating pairs of the plurality of data signals in quadrature onto the source signal transmitted by the source signal generator, at least one modulated pair being output as a first optical data signal having a first polarization state, at least one further modulated pair being output as a second optical data signal, the second data signal being transmitted to a polarization transformer which alters the second optical data signal to a second polarization state.

13. The optical data signal transmitter of claim 12, further comprising:

at least two optical combiners, each combiner coupled to one of the at least one data modulators and one of the at least one polarization transformers;

wherein a first optical combiner combines the first optical data signal with the second optical data signal and sends a combined signal to a second optical combiner where the combined signal is further combined with the modified optical carrier signal.

14. The optical data signal transmitter of claim 10, wherein the at least one optical carrier generator includes a Mach-Zehnder interferometer.

15. The optical data signal transmitter of claim 12, further comprising:

at least one optical phase shifter coupled to at least one data modulator; and

at least one attenuator coupled to the at least one phase shifter;

wherein the at least one optical phase shifter equalizes phases of the first and second optical data signals, and the at least one attenuator equalizes amplitudes of the first and second optical data signals.

16. A method of increasing the data capacity of optical transmission, comprising the steps of:

generating at least one optical carrier signal, each signal having two side frequencies derived from a source frequency;

modulating data onto the at least one optical carrier signal, creating at least one optical data signal including modulated data and having a first polarization state; and

encoding a portion of the modulated data and a first of the two side frequencies of the at least one optical data signal with a second polarization state, the second polarization state being orthogonal to the first polarization state.

17. The method of claim 16, wherein the step of modulating data onto the at least one optical carrier signal includes imprinting data onto information bands, each of the information bands centered at one of the two side frequencies.

18. The method of claim 17, wherein data is modulated onto the at least one optical carrier signal in quadrature.

19. The method of claim 17, further comprising the steps of:

inputting first and second coherent optical source signals having respective first and second source frequencies;

generating a first optical carrier signal from the first source signal and a second optical carrier signal from the second optical source signal;

modulating each of the first and second optical carrier signals with two data signals in quadrature, the data signals having a data rate;

outputting first and second optical data signals having a first polarization state;

transforming the polarization of the second optical data signal to a second polarization state; and

multiplexing the first and second optical data signals.

20. The method of claim 19, wherein the first optical source frequency is at least 50 GHz apart from the second source frequency, and the two side frequencies of the optical carrier signal are located three times the data rate in GHz above and below the source frequency.

21. The method of claim 16, wherein the optical carrier signal includes the source frequency and data is imprinted onto information band centered at the source frequency.

22. An optical receiver, comprising:

an optical splitter for splitting an incoming optical data signal into a first optical data sub-signal and a second optical data sub-signal, each of the sub-signals including a first side carrier frequency having a first polarization state, a second side carrier frequency having a second polarization state, and a central information band, the central information band including first data having the first polarization state and second data having the second polarization state; and

a frequency differentiator, the differentiator acting on the first and second side carrier frequencies differently, enabling the first side carrier frequency and the first data to be separated from the second side carrier frequency and the second data.

23. The optical receiver of claim 22, further comprising:

an optical arrangement for receiving the second optical data sub-signal and separating the first side carrier frequency and first data into a separated first signal and the second side carrier frequency and second data into a separated second signal, the arrangement changing the phase of the separated first side carrier frequency by 180 degrees, and recombining the shifted separated first signal with the separated second signal into a modified optical data signal; and

a hybrid coupler connected to the optical arrangement and the splitter, the hybrid coupler receiving RF-converted versions of the first sub-signal from the splitter and the modified optical data signal from the optical arrangement, the coupler generating sum and difference products, the sum product including an RF converted version of the first side carrier frequency and first data, and the difference product including an RF converted version of the second side carrier frequency and second data.

24. The optical receiver of claim 23:

wherein the optical arrangement includes:

an optical demultiplexer;

an optical shifter coupled to the optical demultiplexer; and

an optical multiplexer coupled to both the optical demultiplexer and the optical shifter.

25. The optical receiver of claim 24, further comprising:

at least two optoelectric converters for converting the optical data sub-signals from the optical domain to the RF domain.

26. The optical receiver of claim 22, further comprising:

two optical filters, each coupled to and receiving an optical data sub-signal from the splitter, the first optical data sub-signal being received by a first optical filter, the second sub-signal being received by a second optical filter, the first filter attenuating the second side carrier frequency and the second data and the second filter attenuating the first side carrier frequency and the first data.

27. The optical receiver of claim 22, further comprising:

an optical filter that separates an optical data sub-signal into two signals, a first signal including a first data band and the first side carrier frequency and the second signal including a second data band and the second side carrier frequency.

28. The optical receiver of claim 27, wherein the first data band of the first signal is attenuated with respect to the first side carrier frequency and the second data band of the second signal is attenuated with respect to the second side carrier frequency.

29. The optical receiver of claim 27, wherein the optical filter demultiplexes an optical data sub-signal into a plurality of input signals, each input signal having different frequencies.

30. The optical receiver of claim 29, wherein the optical filter includes a Fabry-Perot filter, the Fabry-Peror filter having repetitive frequency response.

31. An optical data communication system, comprising:

an optical data signal transmitter, including:

at least one optical carrier generator, each generating an optical carrier signal having two side frequencies derived from a source frequency;

at least one data modulator for modulating data onto the optical carrier signal, creating an optical data signal including modulated data and having a first polarization state; and

at least one polarization transformer for encoding a portion of the modulated data and a first of the two side frequencies of the at least one optical data signal with a second polarization state, the second polarization state being orthogonal to the first polarization state;

an optical fiber for carrying the optical data signal; and

an optical receiver for receiving the optical data signal.

32. The optical data communication system of claim 31, wherein the optical receiver includes:

an optical splitter for splitting an incoming optical data signal into a first optical data sub-signal and a second optical data sub-signal, each of the sub-signals including a first side carrier frequency having a first polarization state, a second side carrier frequency having a second polarization state, and a central information band, the central information band including first data having the first polarization state and second data having the second polarization state; and

a frequency differentiator, the differentiator acting on the first and second side carrier frequencies differently, enabling the first side carrier frequency and the first data to be separated from the second side carrier frequency and the second data.

33. A method for enhancing data capacity in optical data communication, comprising the steps of:

modulating first data onto a first optical carrier onto a data band occupying a data frequency range, the first optical carrier including a first side frequency separated from the frequency range of the data band, resulting in a first modulated carrier having a first polarization state;

modulating second data onto a second optical carrier onto a data band occupying the data frequency range, the second optical carrier including a second side frequency separated from the data frequency range of the data band in a direction opposite from the first side frequency, resulting in a second modulated carrier having a first polarization state;

changing the polarization state of the second modulated carrier to a second polarization state orthogonal to the first polarization state;

combining the first modulated carrier with the second modulated carrier into a combined carrier;

optically transmitting the combined carrier;

receiving the transmitted carrier; and

extracting the first data having the first polarization state from the second data having the second polarization state.

34. The method of claim 19, further comprising the step of:

filtering the multiplexed signal to pass a portion of the multiplexed signal having frequencies located between the first and second source frequencies.